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The Bakerian Lecture. On some of the Combinations of Oxymuriatic Gas and Oxygen, and on the chemical Relations of these Principles, to inflammable Bodies. By Humphry Davy, Esq. LL.D. Sec. R.S. F.R.S.E. M.R.I.A. and M.R.I. Read November 15, 1810. [Phil. Trans. 1811, p. 1.]

Mr. Davy, having in his last communication to the Society expressed his belief that the substance called oxymuriatic acid gas has not yet been decomposed, but is simple, as far as our present knowledge extends, and having been confirmed in that opinion by subsequent experiments, endeavours, on the present occasion, to select such experiments as tend to illustrate more fully the nature, properties, and combinations of this substance with inflammable bodies, and compares its properties with those of oxygen, to which he considers it as bearing the closest analogy.

When potassium is exposed to oxymuriatic gas, the intensity of their mutual attraction occasions spontaneous inflammation. Ten grains of potassium absorb about eleven inches of the gas; and they form a neutral compound, which is the same as muriate of potash which has been ignited. When this metal or sodium are burned in oxygen gas, the combustion is much less vivid, since their attractions for oxygen are feebler than for oxymuriatic gas; and the alkalis, potash, and soda, are formed in a state of extreme dryness; but under certain circumstances they are liable to combine with an excess of oxygen, and to become peroxides, as observed by Messrs. Gay-Lussac and Thenard.

The oxides, when newly formed, being perfectly dry, require a strong red heat to fuse them. When small quantities of water are added to them, they heat violently, and are converted into hydrates that are easily fused, and are in a certain degree volatile.

By ignition they do not lose the whole of the water, but retain a portion, as has been observed by M. Berthollet and M. D'Arcet. Mr. Davy's method of ascertaining the quantity of water retained, was by means of the boracic acid, previously dried by heating to whiteness for nearly an hour; and he found about 16 per cent. in potash, and about 23 in soda. But when potassium, or potash recently prepared from potassium, was employed, and combined with dry boracic acid, no moisture whatever was extracted. It is evident, therefore, that common potash and soda are hydrates, and that the compounds formed by the combustion of the alkaline metals are pure metallic oxides, free from water.

If one grain of potassium be burned in oxygen gas it absorbs half a cubical inch, and if the oxide so formed be subsequently exposed to oxymuriatic gas, then one and one eighth cubic inch of this gas are absorbed, and the half cubic inch of oxygen is extricated. When dry potash, or peroxide of potassium, are heated in oxymuriatic gas, no moisture is extricated, excepting when the gas itself contains aqueous vapour. But when muriatic acid gas was introduced

to potash formed by the combustion of potassium, then water was instantly formed, and oxymuriate of potassium.

The phenomena when sodium or soda are employed, are precisely analogous to the former; but the quantity of oxygen absorbed by sodium, and extricated from it by oxymuriatic gas, is very nearly twice as much as with potassium.

When two parts of potassium are heated with common salt that has been previously dried, the salt is decomposed; and one part of sodium is obtained in a very pure state by an extremely easy process.

From the experiments on sodium contained in the last Bakerian lecture, Mr. Davy deduces the elementary number 22, as representing the proportion in which it unites with different bodies.

He observes also, that the proportions ascertained on the present occasion to exist in the hydrates of potash and of soda, accord with the supposition that they each contain one part of water, combined with one of the respective alkali.

The proportions also of potash or soda in different neutral combinations by these estimates (says Mr. Davy), will be found to agree very nearly with those derived from the most accurate analyses; and as one instance, he refers to Dr. Marcet's analysis of muriate of soda.

Since the muriates of barytes, lime, and strontia, when thoroughly dried by exposure to a white heat, are not decomposable by boracic acid, or by any simple attractions, Mr. Davy was led to suppose that they consisted of their peculiar metallic bases, combined with oxymuriatic gas; and he is confirmed in this opinion by the result of other experiments; for when these earths are heated to redness in oxymuriatic gas, the same dry muriates are formed, and oxygen is expelled. The proportion which this oxygen bears to each earth, Mr. Davy has not yet ascertained; but he found it to be in the constant ratio of one to two in volume of the oxymuriatic gas employed.

When dry quick-lime was heated in muriatic gas, water was immediately formed; and it can hardly be doubted, says Mr. Davy, that this arose from the union of hydrogen from the acid with oxygen from the lime.

The author next endeavoured to obtain the metals of barytes, strontia, and lime, from their muriates by means of potassium; and though he did not succeed in separating them, he is of opinion that either the bases of the earths were wholly or partially deprived of oxymuriatic gas by this process, or that the potassium had entered into triple union with their muriates.

When small portions of the common metals were heated in oxymuriatic gas, they each inflamed, with the exception of gold, silver, and lead.

The product from arsenic was butter of arsenic highly volatile; that from antimony was butter of antimony easily fused, but crystallized when cold. Those from tellurium, zinc, and bismuth, were very similar to the preceding.

The product from mercury was corrosive sublimate.

The compound formed with iron was of a bright brown, iridescent, like the Elba iron ore, volatile at a very moderate heat, and forming brilliant crystals on the sides of the vessel.

Tin afforded Libavius's liquor, having its usual properties.

When instead of the metals themselves their oxides were exposed to the action of oxymuriatic gas, oxygen was given off, in most cases at a heat below redness; and the quantity was the same as had been previously absorbed by the metals.

From the whole of the present series of experiments, Mr. Davy derives confirmation of his former opinion respecting the simple nature of oxymuriatic gas, the leading property of which is its tendency to unite with inflammable bases, forming binary compounds. Since its affinity is in most cases greater than that of oxygen, it either produces the expulsion of the oxygen, or causes it to enter into new combinations. He considers the oxygen that is expelled to arise from the oxide, because it is in proportion to the quantity which the oxide contained, and bears no relation to the quantity of acid.

If the oxymuriatic gas consisted of any acid matter combined with oxygen, its acidity, says Mr. Davy, should appear when it is united to phosphorus. But when two parts of this gas are combined with one of phosphorus, the compound has no effect on litmus paper, and does not act on dry lime or dry magnesia. But by union with hydrogen it forms an acid; in the same manner oxygen communicates acid properties to sulphur and phosphorus.

Although its affinities are in general superior to those of oxygen, Mr. Davy notices some exceptions. For instance, the boracic and phosphoric acids are not decomposed by it; and the same appears to be the case with the peroxides of iron and arsenic.

Of all the different bodies supposed to be elementary, nitrogen is that which has the weakest tendencies to combination in general; and it does not hitherto appear to have any affinity for oxymuriatic gas.

With respect to the simple or compound nature of nitrogen, Mr. Davy has not yet arrived at any satisfactory conclusion, although the general result of his attempts to decompose it has shown an apparent evolution of hydrogen, and other effects which could only be ascribed to the presence of oxygen.

But, on the contrary, the numerical expression for nitrogen, which corresponds to 13.4, does not accord with any simple proportion of oxygen and hydrogen; and this, together with other circumstances, occasion Mr. Davy to resist the inference of its being decomposed.

The author concludes with reflections on the nomenclature of oxymuriatic gas, and its compounds; since it appears to him that an alteration is necessary to assist the progress of discussion, and to diffuse just ideas on the subject.

It is to be regretted that the great discoverer of this substance did not originally affix to it a simple name to which we might now recur; but his term dephlogisticated can hardly be adopted in the present state of science.

Mr. Davy, preferring some name founded upon one of its obvious and characteristic properties, proposes *chloric gas*, which does not imply any error, and would not require to be changed, even if it should hereafter be discovered to be a compound.

For expressing the compounds of this substance with other bodies, he is not disposed to employ the same term, but proposes adding to each base the terminal syllable *ine*, which is to imply the presence of the chloric base. Thus horn silver is to be called *argentine*; butter of antimony, *antimonine*, &c. He conceives also, that by means of vowels prefixed to the name, the proportion in which this body is combined with others may be conveniently expressed.

The Croonian Lecture. On some Physiological Researches, respecting the Influence of the Brain on the Action of the Heart, and on the Generation of animal Heat. By Mr. B. C. Brodie, F.R.S. Read December 20, 1810. [Phil. Trans. 1811, p. 36.]

It has been observed by Mr. Cruickshank, and the same observations have been made by M. Bichat (in his *Récherches Physiologiques sur la Vie et la Mort*), that the brain is not directly necessary to the action of the heart; and that when the functions of the brain are destroyed, the circulation of the blood ceases only in consequence of the suspension of the respiration.

The former of these observations Mr. Brodie had found to be correct; for if the spinal marrow were divided, though the respiration was thereby immediately stopped, still the heart continued to contract, and to propel forward, for a short time, dark-coloured blood; and even when the head was entirely removed, if the blood-vessels were secured by ligature, the circulation seemed unaffected by the entire separation. It appeared, therefore, in conformity to the second observation, to cease solely in consequence of the suspension of respiration; but Mr. Brodie conceived that this point might admit of direct proof by experiment; for in that case the heart should continue to act for a greater length of time, if the process of respiration were carried on artificially.

The present lecture comprises the details of his experiments on this subject.

The first experiment was made upon a rabbit, the head of which was removed after the blood-vessels had been tied up; and the lungs were then inflated artificially once in five seconds, during twenty-five minutes. The circulation of the blood was found to continue the whole of that time; but it was observed that no secretion of urine took place.

The second experiment was made upon a middle-sized dog, for the purpose of ascertaining also, whether the animal heat was kept up to its natural standard. At the end of two hours the pulse continued as high as seventy, but in the next half hour it was found to have declined rapidly, and the artificial respiration was discontinued. At the end of one hour a thermometer in the rectum had fallen 6° ;